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Development of eco-friendly management approach against sucking and borer insect pest complex in Chilli

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Abstract

Experiments were conducted at Regional Agricultural Research Station, Jamalpur during the period from September 2017 to March 2018 to find out the appropriate management approach for controlling major insect pests in chilli. Spraying of Spinosad (Success 2.5SC) and Abamectin (Toximite 1.8EC) along with blue & yellow sticky traps was found effective for controlling sucking insect pest in chilli. Mass trapping of *Spodoptera litura* and *Helicoverpa armigera* along with the spraying SNPV and HNPV @ 0.2g/l of water and Spinosad (Success 2.5SC) @ 1.2ml/l of water was found effective for controlling borer complex of chilli. A long-term pest population decrease is not achieved through only spraying chemical insecticides. In contrast, mass trapping with pheromone lures along with different bio-pesticides are eco-friendly, inexpensive, reliable and it facilitates the Integrated Pest Management (IPM) concept.

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Introduction

Chilli (*Capsicum frutescens* L.) is an important income generating spices crop in Bangladesh. Among the different important spices crops, chilli is one of them and green chillies are important source of antioxidants which can protect our body from free radical damage and it gives us natural immunity to cancer. Green chilli slows down the ageing process providing huge amount of vitamin A and C. About two lakh thirty one thousand seventy seven acres of land is cultivated in Bangladesh every year both summer and winter and about one lakh two thousand two hundred fifty one tons dry chillies are produced (BBS, 2014). Among the major chilli growing areas in Bangladesh, Jamalpur is one of them. Only the farmers of Madargonj Upazilla cultivate local "Baliguri" variety in 3000-3500 ha area of land among seven Upazillas of Jamalpur district. Recently a lot of problems are faced by the farmers to cultivate chilli. Different insect pests contribute to lower productivity of chilli. Upward and downward leaf curling due to infestation of different sucking insect pests caused 60-80% economic yield loss qualitatively (Ghosh *et al.*, 2009). Major constraints for chilli production are various sucking insect pests like mite, thrips, jassid, aphids and some borer complex (*Spodoptera litura* and *Helicoverpa armigera*) (Kambrekar, 2013). Now *Spodoptera litura* is a burning issue and extremely serious pest in chilli. Females lay 1000-2000 eggs in egg masses of 100-300 underneath leaves between 2 and 5 days after emergence. Farmers spray different insecticides frequently for controlling this pest without any pre-harvest interval and it causes pest resistance, resurgence and environmental health hazard.

Resistance to some selected newer insecticides along with organophosphorus, carbamate and pyrethroids groups in *Spodoptera litura* caused sporadic out breaks and drastically failure of the crop (Ahmad, 2004., Saleem, 2008., Ahmad *et al.*, 2008., Hong *et al.*, 2013 and Shad *et al.*, 2012). It is becoming a threat to the chilli, cabbage, cauliflower, tomato, aroids, jute etc. Insect pests of chilli can be managed effectively, economically and eco-friendly through the integration of different IPM components. Very few research works have been done to solve these problem although chilli production is hampered due to insect infestation.

Under these circumstances, in order to promote the supply of safe chilli for both domestic and export market, IPM technology needs to be developed. Major emphasis is urgently needed to find out the appropriate management approaches through bio-control agents, bio-pesticides, other mechanical and cultural practices to ensure safe food security and socio economic development of char land people through IPM approach for chilli production

Materials and methods

Development of eco-friendly management approach against sucking insect pest complex in chilli

Two experiments were conducted (one in the tubs and another one in the field) at Regional Agricultural Research Station, Jamalpur during the period from September 2017 to March 2018 to study the effectiveness of five different treatments against sucking insect pests by using most susceptible chilli cultivar "Bindhu" which was found susceptible against major insect pests. Five treatments were T_1= Azadirachtin (Bioneem plus 3EC) @ 1ml/l of water + Blue & yellow sticky traps + Abamectin (Toximite 1.8EC) @1.0ml/l of water, T_2= Spinosad (Success 2.5SC) @ 1.2ml/l of water + Blue & yellow sticky traps + Abamectin (Toximite 1.8EC) @1.0ml/l of water, T_3= Alternate spraying of Azadirachtin (Bioneem Plus) @ 1ml/l of water & Spinosad (Success 2.5SC) @ 1.2ml/l of water + Abamectin (Toximite 1.8EC) @1.0ml/l of water, T_4= Spraying of Spinosad (Success 2.5SC) @ 1.2ml/l of water and T_5= untreated Control.

Two colors (blue and yellow) were used as treatments together. Specific colors were provided using special plastic boium which were fixed up on bamboo sticks above the crop for proper visibility and convenient handling for counting sucking insects that stuck on glue on the upper side of the boium. Five treatments including the control were randomly allocated among chilli plots in each replicate. Colored boiums were introduced for six weeks starting from two weeks after transplanting.

The soil of the experimental plot was loamy sand in texture. The tub experiment was laid out in CRD and field experiment was in RCBD design with three replications. The crop was raised in the nursery and 30 days old seedlings were transplanted in both the experiments. In the field experiment the plot size was maintained as 3mx2.5m with the spacing of 50cmx50cm. Standard agronomic practices were followed to grow the crop. Tubs were placed in front of the Field Laboratory building of Regional Agricultural Research Station, Jamalpur. Single plant was grown in a tub and proper agronomic practices were maintained. Each plant of a tub was tagged for recording data. Five twigs were selected randomly from each plant and tagged for recording data. Three leaves from each plant were plucked and kept in properly labeled polypropylene bag. To study the sucking insect pest population, each twig was shaken gently. Mite and thrips were noted down which fell on the white paper. The data were calculated and average mean data were presented in a table 1.

Fig. 1. Study on development of management approach for controlling sucking insect pest complex of chilli in tubs.

Fig. 2. Study on development of management approach for controlling sucking insect pest complex of chilli in the field.

Development of eco-friendly management approach against borer insect pest complex in chilli

Two experiments were conducted (one in the tubs and another one in the field) at Regional Agricultural Research Station, Jamalpur during the period from September 2017 to March 2018 to study the effectiveness of five different treatments against borer insect pest complex by using most susceptible chilli cultivar "Bindhu". Experiments were laid out with 3 dispersed replications in tubs and in the field. The treatments were T_1= Mass trapping of *Spodoptera litura* and *Helicoverpa armigera* through pheromone lure, T_2= Mass trapping of *Spodoptera litura* and *Helicoverpa armigera* through pheromone lure + spraying of SNPV and HNPV @ 0.2g/l of water, T_3= Mass trapping of *Spodoptera litura* and *Helicoverpa armigera* + spraying of SNPV and HNPV @ 0.2g/l of water + spraying of Spinosad (Success 2.5SC) @1.2ml/l of water, T_4= Spraying of Spinosad (Success 2.5SC) @1.2ml/l of water and T_5= Untreated Control.

Traps were placed with equal spacing of 20m×20m between traps in the field. In the tub experiment one trap was set for 30 tub plants. For the fulfillment of scientific condition of the sex pheromone, untreated control plots were placed 500m away from the sex pheromone plot. After harvesting, all data were collected accordingly and subjected to statistical analysis.

Fig. 3. Study on development of management approach for controlling borer insect pest complex of chilli.

Results and discussions

Development of eco-friendly management approach against sucking insect pest complex in chilli

Different treatments were applied in the tub and in the field for the management of sucking insect pests of chilli. The results of the study were presented in Table 1. Significant variation in mean number of thrips and mites per leaf was found in different treatments at 72 hours after spray (Table 1). The lowest number of thrips and mites were recorded from the treatment spraying of Success 2.5SC and Toximite 1.8EC along with the blue & yellow sticky traps which was statistically same with the spraying of Bioneem plus and Toximite and alternate spraying of Bioneem plus and Toximite along with the blue and yellow sticky traps. The highest number of thrips and mite population was recorded from untreated control plots. It is noted that the thrips and mite population was always higher in the field than the tub plants.

Table 1. Effect of different IPM approaches for controlling thrips and mites of chilli in tub and field.

Treatment	No of thrips/twig				No of mites/leaf			
	Before spray		After spray (72 hrs)		Before spray		After spray (72 hrs)	
	Tub	field	Tub	Field	Tub	field	Tub	Field
T_1= Bioneem plus 3EC @ 1ml/l + Blue & yellow sticky traps + Toximite 1.8EC) @1.0ml/l	5.36	7.36	3.01bc	2.07 c	3.69	3.01	1.47 c	0.97 bc
T_2= Success 2.5SC @ 1.2ml/l + Blue & yellow sticky traps + Toximite 1.8EC @1.0ml/l	5.34	6.67	1.78 c	1.97 c	3.34	3.69	1.24 c	0.71 c
T_3= Alternate spraying of Bioneem plus 3EC @ 1ml/l & Success 2.5SC@ 1.2ml/l + Toximite 1.8EC @1.0ml/l	6.21	6.89	2.12c	2.68c	2.97	3.23	1.56 c	0.91c
T_4= Spraying of Success 2.5SC@ 1.2ml/l	5.67	6.01	4.11b	5.13 ab	3.36	3.83	3.51b	2.35 ab
T_5= Untreated Control	7.68	8.28	6.38 a	6.98 a	4.56	4.56	4.67a	3.10 a
Level of significance	NS	NS	**	**	NS	NS	*	**
CV(%)	24.38	19.35	9.47	10.31	19.37	18.54	14.35	11.25

Fig. 4. Use of color traps for controlling major sucking insect pests in chilli.

Hossain *et al.* (2016) showed the lowest thrips (0.86 thrips/leaf) and mite (0.97 mites/leaf) population with highest marginal benefit cost ratio (33.02) spraying of Chlorphenapyr (Intrepid 10SC) @ 1ml/l of water along with white sticky trap @ 40 traps/ha. Sunitha and Narasamma (2018) reported that spraying of Spinosad 45SC @ 0.1ml/l and Emamectin Benzoate 5% SG @ 0.25g/l with solar light traps were found effective for the management of thrips in capsicum. The use of white sticky trap and spraying of Spinosad 2.5SC (Success 2.5Sc) @ 1.2ml/l of water and Chlorfenapyr (Intrepid 10SC) is best method for controlling thrips in chilli (Annonymous, 2013 and Annonymous, 2014). The use of white sticky trap along with the spraying of Abamectin @ 1.2ml/l of water and Azadirachtin (Bioneem plus) @ 1ml/l of water showed the best performance against thrips-mite complex of chilli (Annonymous, 2015). Different color traps (blue, yellow, and white) were evaluated for attraction and capture of chilli thrips, *Scirtothrips dorsalis* and results revealed that blue traps caught more thrips (Matthew, 2006). Chilli thrips,

Scirtothrips dorsalis Hood were monitored through different colour sticky traps and the sequence of thrips attraction was as in order blue> yellow> pink> white under both field and polyhouse conditions (Sridhar and Naik, 2015). In both experimental conditions, maximum trap catch of S. dorsalis was significantly higher in blue traps. There were partial agreements of the present study with the results of Hossain *et al.* (2016), Sunitha and Narasamma (2018), Annonymous (2013), Annonymous (2014) and Annonymous (2015). In the present study blue and yellow sticky traps were found effective which was supported by Matthew (2006) and Sridhar and Naik (2015).

Development of eco-friendly management approach against borer insect pest complex in chilli

Chilli fruits are infested by borer insect pest complex of *Spodoptera litura* and *Helicoverpa armigera* after fruiting. Five treatments were applied for controlling these pests. From Table 2 it was found that the lowest percentage of infested fruits and highest yield were recorded from the treatment mass trapping of *Spodoptera litura* and *Helicoverpa armigera*+ spraying of SNPV and HNPV @ 0.2g/l of water + spraying of Spinosad (Success 2.5SC) @1.2ml/l of water which was statistically same with the treatment mass trapping of *Spodoptera litura* and *Helicoverpa armigera* through pheromone lure + spraying of SNPV and HNPV @ 0.2g/l of water. Although the level of infestation was statistically same between two above treatments, it was comparatively lower in the first one than the second one. It might be due to spraying of bio-pesticide Spinosad. The highest percentage of infested fruits and lowest yield was recorded from untreated control plots.

Table 2. Effect of different treatments for controlling chilli borer complex.

Treatment	Infested fruits (%)		Yield (t/ha)		Insect captured/ trap/ week (no)	
	Tub	Field	Tub	Field	Tub	Field
T_1= Mass trapping of *Spodoptera litura* and *Helicoverpa armigera* through pheromone lure	9.36 b	10.65 b	8.97 b	11.35 b	59	235
T_2= Mass trapping of *Spodoptera litura* and *Helicoverpa armigera* through pheromone lure + spraying of SNPV and HNPV @ 0.2g/l of water	5.36 c	6.37bc	9.25ab	12.35 a		
T_3= Mass trapping of *Spodoptera litura* and *Helicoverpa armigera*+ spraying of SNPV and HNPV @ 0.2g/l of water + spraying of Spinosad (Success 2.5SC) @1.2ml/l of water	3.67 c	3.15 c	10.35 a	13.25 a		
T_4= Spraying of Spinosad (Success 2.5SC) @1.2ml/l of water	11.68 b	12.38 b	7.36 b	10.23 b		
T_5= Untreated Control.	24.36 a	26.36 a	5.59 c	7.38 c		
Level of significance	**	**	**	*		
CV(%)	13.67	9.97	11.45	15.39		

Fig. 5. Use of pheromone traps for controlling borer insect pests in chilli field.

Weekly release of *Bracon hebetor*, mass trapping of *Spodoptera litura* and two sprays of SNPV and HNPV for controlling borer complex of chilli performed better (Annonymous, 2012). Mass trapping through pheromone lures was reported to manage a range of insect pest Lepidoptera, Coleoptera, Homoptera and Diptera (El-Sayed *et al.*, 2009 and Witzgall *et al.*, 2010). Continuous long-term use of pheromone based management approach decreased population levels of target species (Varner *et al.*, 2001and Ioriatti *et al.*, 2008). However in the present study mass trapping along with the bio-pesticides was found effective for

controlling borer pest complex of chilli which was supported by the above authors.

Conclusion

Chilli crops are ravaged by different sucking insect pests and borer complex (*Spodoptera litura* and *Helicoverpa armigera*) in Bangladesh. In the present study some management packages were tested for controlling sucking and borer insect pest complex. Spraying of Spinosad (Success 2.5SC) @1.2ml/l of water and Abamectin (Toximite 1.8EC) @1.0ml/l of water along with the blue & yellow sticky traps were found significantly applicable over the control in reducing the thrips and mite population in chilli in terms of sucking pest management. Mass trapping of *Spodoptera litura* and *Helicoverpa armigera* through pheromone lures + spraying of SNPV and HNPV @ 0.2g/l of water + spraying of Spinosad (Success 2.5SC) @ 1.2ml/l of water was found very effective in reducing fruit borer complex and significantly enhancing the yield over control.

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